Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

CODE 590

(ac)

DEFINITION

Manage the rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.

PURPOSE

This practice is used to accomplish one or more of the following purposes–

- Improve plant health and productivity
- Reduce excess nutrients in surface and ground water
- Reduce emissions of objectionable odors
- Reduce emissions of particulate matter (PM) and PM precursors
- Reduce emissions of greenhouse gases (GHG)
- Reduce emissions of ozone precursors
- Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water
- Improve or maintain soil organic matter

CONDITIONS WHERE PRACTICE APPLIES

All fields where plant nutrients and soil amendments are applied. This practice does not apply to onetime nutrient applications at establishment of permanent vegetation.

CRITERIA

General Criteria Applicable to All Purposes

Plans for nutrient management shall comply with all applicable federal, state, and local laws and regulations.

Plans for nutrient management shall be developed in accordance with policy requirements of the NRCS *General Manual*, Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS *Field Office Technical Guide* (FOTG); procedures contained in the *National Planning Procedures Handbook* (NPPH), the NRCS *National Agronomy Manual* (NAM) Section 503, and the *Maryland Nutrient Management Manual* (COMAR 15.20.07-.08).

Persons who review or approve plans for nutrient management shall be certified through the Maryland Department of Agriculture – Nutrient Management Certification Program (including reciprocity agreements). Maryland NRCS may require that additional training be taken to implement current or future

NRCS policy. (Refer to the Maryland Nutrient Management Regulations, COMAR 15.20.04 - Nutrient Management Certification and Licensing.)

Plans for nutrient management that are elements of a more comprehensive conservation plan shall recognize other requirements of the conservation plan and be compatible with its other requirements.

Develop a nutrient management plan for nitrogen (N), phosphorus (P), and potassium (K), which accounts for all known measurable sources and removal of these nutrients.

Sources of nutrients include, but are not limited to, commercial fertilizers (including starter and in-furrow starter/pop-up fertilizer), animal manures, legume fixation credits, green manures, plant or crop residues, compost, organic by-products, municipal and industrial biosolids, wastewater, organic materials, estimated plant available soil nutrients, and irrigation water.

Nutrient management plans shall specify the form, source, amount, timing, method of application, and incorporation, if applicable, of nutrients on each field to achieve realistic yield goals, while minimizing nitrogen and/or phosphorus movement to surface and/or ground waters, and the degradation of soil and air quality.

Plan and implement conservation practices to address soil erosion, runoff, and water quality, as applicable, on fields that receive nutrients.

When irrigating, apply irrigation water in a manner that reduces the risk of nutrient loss to surface and ground water.

Follow all applicable state requirements and regulations when applying nutrients near areas prone to contamination, such as designated water quality sensitive areas (e.g., lakes, ponds, rivers and streams, sinkholes, wellheads, classic gullies, ditches, and surface inlets) that run unmitigated to surface or groundwater. Nutrient applications must be consistent with minimum application setback restrictions as required by Maryland nutrient management regulations (Maryland Nutrient Management Manual, Supplement No. 8, *Nutrient Application Requirements,* Regulatory Citation: COMAR 15.20.07.02).

Maintain soil pH within ranges which enhance the adequate level for plant or crop nutrient availability and utilization. Refer to University of Maryland documentation for guidance.

Soil and Tissue Testing and Analysis
Base the nutrient management plan on current soil test results in accordance with University of Maryland recommendations. Use soil tests preferably taken within 2 years, but no older than 3 years, when developing new nutrient management plans. For nutrient management plan revisions and maintenance, take soil tests on an interval recommended by the University of Maryland and as required by local rules and regulations. Current soil tests are those that are no older than 3 years, based on Maryland nutrient management regulations.

Soil samples shall be collected and prepared according to the University of Maryland guidance and recommendations or standard industry practice. Soil test analyses shall be performed by laboratories that:

- Use methods recommended for Maryland soils and included in the regional bulletins on recommended soil testing methods for the northeastern or southeastern United States (Sims and Wolf, 1995; Donohue, 1992) published by the USDA regional committees on soil testing – NEC-67 and SERA-6. A list of recommended methods is available from the University of Maryland and NRCS.
- Meet the requirements and performance standards of the North American Proficiency Testing Program under the auspices of the Soil Science Society of America and NRCS, or use an alternative NRCS- or University of Maryland- approved certification program that considers laboratory performance and proficiency to assure accuracy of soil test results.
- Provide soil test results for nutrients in units that are convertible to the University of Maryland’s

Fertility Index Values (FIV). Tables for converting soil test results from other laboratories to equivalent University of Maryland FIVs are available from the University of Maryland.

Tissue sampling and testing, where used, shall be conducted in conjunction with a current soil test and in accordance with University of Maryland guidelines and recommendations.

Manure, Organic By-Product, and Biosolids Testing and Analysis
Collect and analyze manure, organic by-products, and biosolids in accordance with Maryland Nutrient Regulations (COMAR 15.20.08.05), or more frequently if needed to account for operational changes impacting manure nutrient concentrations.

Follow University of Maryland guidelines regarding required analyses and test interpretations. Analyze, as a minimum, total N and ammonium N, total P or P_2O_5, total K or K_2O, and percent solids.

Collect samples in accordance with recommendations of the University of Maryland, and as close to the application date as feasible. Allow adequate time for the analyses, clean-out, spreader calibration, and field application. See University of Maryland Nutrient Management NM-6, May 2007 – *Sampling Manure for Nutrient Content.*

When planning for new or modified livestock operations, and manure tests are not available yet, an NRCS and/or University of Maryland acceptable “book value” may be used for planning purposes. Book values recognized by NRCS may be found in the *Agricultural Waste Management Field Handbook*, Chapter 4, “Agricultural Waste Characteristics.” Analyses from similar operations in the geographical area may also be used if they accurately estimate nutrient output from the proposed operation. In the first year, an actual sample shall be obtained and analyzed, and the plan revised to reflect the test results.

For manure analyses, use laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification program under the auspices of the Minnesota Department of Agriculture or other NRCS-approved program that considers laboratory performance and proficiency to assure accurate manure test results. Analyses will be performed through a testing laboratory whose techniques are consistent with those recommended by the University of Maryland.

For nutrient management plans developed as a component of a comprehensive nutrient management plan for an animal feeding operation (AFO), follow policy in the NRCS *General Manual* (GM) 190, Part 405, “Comprehensive Nutrient Management Plans.” These plans must include documentation of all nutrient imports, exports, and on-farm transfers.

Nutrient Loss Risk Assessments
Use current NRCS-approved nitrogen, phosphorus, and soil erosion risk assessment tools to assess the site-specific risk of nutrient and soil loss.

Nitrogen Loss
Nitrogen leaching is not a risk to water quality, including drinking water in the State of Maryland, based on the Maryland Department of Agriculture requirements for the use of best management practices to reduce the risk nitrogen leaching on all sites. Such mitigating practices include the use of cover crops, timing of application and application setbacks. These mitigating practices can be found in the Maryland Department of Agriculture 2012 Nutrient Application Requirements, Regulatory Citation: COMAR 15.20.07.02.

Phosphorus Loss
Complete an NRCS-approved nutrient risk assessment for P, using the University of Maryland Phosphorus Management Tool (UM-PMT), when a soil sample analysis shows a phosphorus fertility index value (FIV) of 150 or greater (COMAR 15.20.08.09).

Details on the proper method to conduct a UM- PMT assessment are available from the University of Maryland and Maryland Department of Agriculture, and as provided in the *Maryland Nutrient Management Manual,* Section II-C2.

When a P risk assessment is required, nutrient management plans shall include:

- A record of the UM-PMT risk assessment ratings for each field or management unit,
- Nutrient application rates as required in COMAR 15.20.08, based on the UM-PMT risk assessment ratings of High, Medium, and Low.
- Information about conservation practices and management activities that can reduce the potential for nitrogen and phosphorus movement from the site.

Note: The use of certain conservation practices can reduce the risk of P movement, thereby lowering the risk level from a higher category to a lower category. If recommended conservation practices will be implemented by the operator, either before or during P application to reduce the risk level to a lower category, then nutrient application rates may be based on the lower risk category.

Any fields excluded from a P risk assessment must have a documented agronomic need for P, based on soil test P and University of Maryland nutrient recommendations.

The 4Rs of Nutrient Stewardship
Manage nutrients based on the 4Rs of nutrient stewardship—apply the right nutrient source at the right rate at the right time in the right place—to improve nutrient use efficiency by the crop and to reduce nutrient losses to surface and groundwater and to the atmosphere.

Nutrient Source
Choose nutrient sources compatible with application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic content, and local climate to minimize risk to the environment.

Determine nutrient values of all nutrient sources (e.g. commercial fertilizers, manure, organic byproducts, biosolids) prior to land application.

Determine nutrient contribution of cover crops, previous crop residues, and soil organic matter.

For operations following USDA's National Organic Program, apply and manage nutrient sources according to program regulations.

For enhanced efficiency fertilizer (EEF) products, use products defined by the Association of American Plant Food Control Officials as EEF and recommended for use by the University of Maryland.

In areas where salinity is a concern, select nutrient sources that limit the buildup of soil salts. When manures are applied, and soil salinity is a concern, monitor salt concentrations to prevent potential plant or crop damage and reduced soil quality.

Apply manure or organic by-products on legumes at rates no greater than the University of Maryland estimated N removal rates in harvested plant biomass, not to exceed P risk assessment limitations. To calculate the amount of manure available for crop utilization from different animal types and production systems, use the University of Maryland *Manure Quantity Estimation Sheets* (Microsoft Excel spreadsheets) located at: https://extension.umd.edu/learn/3-manure-sampling-and-testing.

For any single application of nutrients applied as liquid (e.g., liquid manure, nutrients in irrigation water, fertigation):

- Do not exceed the soil's infiltration rate or water holding capacity.
- Apply so that nutrients move no deeper than the current crop rooting depth.
- Avoid runoff or loss to subsurface tile drains.

Nutrient Rates
Plan nutrient application rates for N, P, and K based on University of Maryland recommendations that consider crop/cropping sequence, current soil test results, soil productivity class, expected realistic yield

goals, climate, and management capabilities. Refer to the *Maryland Nutrient Management Manual*, Section I-B1-B6 for crop specific nutrient recommendations. Lower-thanrecommended nutrient application rates are permissible if the client's objectives are met.

For new crops or varieties where University of Maryland guidance is unavailable, industry-demonstrated yield and nutrient uptake information may be used.

Estimate realistic yield potentials or realistic yield goals using University of Maryland procedures or based on historical yield or growth data, soil productivity information, climatic conditions, nutrient test results, level of management, and/or local research results considering comparable management and production conditions.

Maryland's nutrient management regulations require crop yield goals to be based on an average of the 3 highest-yielding years for the crop out of the latest consecutive 5-year cropping sequence; or if yield information exists for more than 5 years for a given field or management unit, crop yield calculations may be based on the average of 60 percent of the highest-yielding years for all consecutive years that crop yield information is available (COMAR 15.20.08.05).

In the absence of yield data for a specific land unit, refer to soil productivity charts in the NRCS *Field Office Technical Guide* (FOTG), or use nearby fields or management units with similar soil types and management conditions to determine a yield goal based on an average of the 3 highest-yielding years for the crop out of the latest consecutive 5-year cropping sequence.

Determine the planned rates of nutrient application, as documented in the nutrient management plan, based on the following guidance:

- *Inorganic/Commercial Fertilizer Applications* - Nitrogen, potassium and micronutrient application rates shall not exceed the recommended rates established by the University of Maryland and written in the nutrient management plan for each field or management unit. Phosphorus application rates should be based on the results of a soil test and/or P risk assessment of the field or management unit.
  When forage quality is an issue associated with excess potassium application, state standards shall be used to set forage quality guidelines.

- *Manure/Organics Applications* - The planned rates of manure and organic by-product nutrient application rates shall be based on nutrient analysis procedures recommended by the University of Maryland. As previously indicated, "book values" may be used in planning for new operations. At a minimum, manure analyses shall identify nutrient and specific ion concentrations, percent moisture, and percent organic matter. Salt concentration shall be monitored so that manure applications do not cause plant damage or negatively impact soil quality.

  The application rate (in/hr) of liquid materials applied shall not exceed the soil intake/infiltration rate and shall be adjusted to minimize ponding and avoid runoff. The total application shall not exceed the field capacity of the soil and shall be adjusted, as needed, to minimize loss to subsurface tile drains.

  Where non-farm organic waste (e.g., municipal sewage sludge) is to be utilized, recommended application rates will be determined by using current University of Maryland recommendations. These materials must also be applied to meet federal, state or local regulations. Appropriate documentation of amounts applied must be maintained by the applicator according to state regulations. The Maryland Department of Environment regulates the land treatment of wastes.

  When sewage sludge is applied, the accumulation of potential pollutants, including arsenic, cadmium, copper, lead, mercury, selenium, and zinc, in the soil shall be monitored in accordance with the US Code, Reference 40 CFR, Parts 403 and 503, and/or any applicable state and local laws and regulations.

- *Irrigated Nutrients* - When irrigation is used, the nitrogen content of the irrigation water shall be Determined and considered in the overall crop nutrient budget and included in the nutrient management plan. A fact sheet on this topic (Fertigating with Groundwater Nitrogen) is available from the University of Maryland. The application rate (in/hr) for material applied through irrigation shall not exceed the soil intake/infiltration rate. The total application shall not exceed the field capacity of the soil.
- *Liming Material* - Soil amendments should be applied, as needed, to adjust soil pH to the specific range of the crop for optimum availability and utilization of nutrients. Such applications shall be in accordance with the University of Maryland guidelines and recommendations. If the liming material also provides plant nutrients (e.g., as with lime-stabilized biosolids), especially N and P, the application rates of these nutrients must be considered in the nutrient management plan.
- *Other Plant Nutrients* - The planned rates of application for other nutrients shall be consistent with University of Maryland guidelines and recommendations.
- *Starter Fertilizers* - Starter fertilizers may be applied in accordance with University of Maryland guidelines and recommendations. When starter fertilizers are used, they shall be considered in the overall crop nutrient budget and included in the nutrient management plan.

Nutrient Application Timing and Placement

Consider the nutrient source, management and production system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment to develop optimal timing of nutrients. For N, time the application as closely as practical with plant and crop uptake. For P, time planned surface application when runoff potential is low. Time the application of all nutrients to minimize potential for soil compaction.

For crop rotations or multiple crops grown in one year, do not apply additional P if it was already added in an amount sufficient to supply all crop nutrient needs.

To avoid salt damage, follow University of Maryland recommendations for the timing, placement, and rate of applied N and K in starter fertilizer.

Nutrient application in Maryland is prohibited when the soil is saturated, when the ground is covered with snow greater than one inch, or when the ground is hard-frozen greater than two inches. Follow Maryland Department of Agriculture nutrient management regulations and recommendations from the *Maryland Nutrient Management Manual*.

Additional Criteria to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater

Apply conservation practices to reduce the risk of soil erosion, nitrogen, and phosphorus movement from the field by surface flow, leaching, or subsurface drainage (e.g., tile, karst) when there is a significant risk of transport of nutrients.

Follow application setback restrictions to reduce nutrient runoff to surface waters, as required by Maryland Department of Agriculture regulations.

Additional Criteria to Reduce the Risk of Potential Pathogens from Manure, Biosolids, or Compost Application from Reaching Surface and Groundwater

When applicable, follow proper biosecurity measures as provided in the NRCS *General Manual* (GM)130, Part 403, Subpart H, “Biosecurity Preparedness and Response.”

Follow all applicable federal, state, and local laws and policies concerning the application of manure, biosolids, or compost in the production of fresh, edible crops.

Apply manure, biosolids, or compost with minimal soil disturbance or by injection into the soil unless it is being applied to an actively growing crop, a minimum of 30 percent residue exists, or there is a living cover that has a fibrous root system with 75 percent or more cover. Do not surface apply manure if a storm event is forecast within 24 hours.

Additional Criteria to Reduce Emissions of Objectionable Odors, PM and PM Precursors, and GHG and Ozone Precursors

To address air quality concerns caused by odor, N, sulfur, and particulate emissions; adjust the source, timing, amount, and placement of nutrients to reduce the negative impact of these emissions on the environment and human health.

Do not surface apply solid nutrient sources, including commercial fertilizers, manure, or organic by-products of similar dryness/density when there is a high probability that wind will blow the material and emissions offsite. Do not surface apply liquid nutrient sources when there is a high probability that wind will blow the liquid droplets applied from sprinklers or other applicable methods offsite.

Reduce the potential for volatilization by applying sources subject to volatilization during cooler, higher humidity conditions or by placement that minimizes vulnerability to volatilization.

Additional Criteria to Improve or Maintain Organic Matter

Design the plant or crop management systems so the soil conditioning index (SCI) organic matter subfactor is positive.

Apply manure, compost, or other organic nutrient sources at a rate and with minimal disturbance that will improve soil organic matter without exceeding acceptable risk of N or P loss.

For low residue plant or cropping systems, apply adequate nutrients to optimize plant or crop residue production to maintain or increase soil organic matter.

Note: Specific programs may dictate criteria in addition to, or more restrictive than, those specified in this standard.

CONSIDERATIONS

Nutrient management planning relies heavily upon regular soil and manure testing, using proper sampling techniques and analytical methods, realistic expected yield goals, consideration of the effects of cover crops and/or crop rotations on nutrient cycling and availability for plant uptake, and the timing and placement of plant nutrients.

Consider the following when developing a nutrient management plan:

- Water quality standards and designated use limitations that exist locally or statewide in managing nutrients to protect the quality of water resources that are affected by the use of nutrients.
- Nutrient application setback distances from environmentally sensitive areas, such as streams, water bodies, sinkholes, wells, gullies, ditches, surface inlets, or rapidly permeable soil areas.
- All sources and forms of nutrients available for plant growth and production (inorganic and organic) and how they affect the crop nutrient budget for the proposed crop and target yield.
- Effects of the seasonal water budget and water table management or controlled drainage on nutrient balance, availability, and potential nutrient losses from the plant environment to surface or ground water or to the atmosphere.
- Cover crops following crop harvest, where appropriate, to utilize and recycle residual nutrients and control soil erosion. Timely planting of cover crops is essential if they are to be effective.
- The importance of soil tilth and organic matter content on plant nutrient absorption, root development, and water infiltration.
- Implementing a soil health management system that reduces tillage or other soil disturbance, includes a diverse rotation of crops and cover crops, keeps roots growing throughout the year, and keeps the soils covered to reduce nutrient losses, and improves:
    - Nutrient use efficiency, rooting depth, and availability of nutrients.
    - Soil organic matter levels.

  - Availability of nutrients from organic sources.
  - Aggregate stability and soil structure.
  - Infiltration, drainage, and aeration of the soil profile.
  - Soil biological activity.
  - Water use efficiency and available moisture.
- Recent test results, of soil, plant, manure, and wastewater used for irrigation when developing nutrient management plans, particularly if animal manures or organic amendments are used as a nutrient source, or if any crop/farming practices have been significantly altered.
- The use of additional conservation practices that can reduce the transport and leaching of dissolved and attached nutrients, improve soil nutrient and water storage, enhance efficiency of nutrient uptake, improve aeration and soil tilth, and protect or improve water quality.
- Adjustments to rate, timing, placement, method of application, and nutrient form to conform to seasonal variation in plant uptake patterns, reduce soil fixation, and avoid excessive soil solution nutrient concentrations.
- Using an adaptive approach to adjust nutrient rate, timing, form, and placement as soil biologic functions and soil organic matter changes over time. See NRCS Agronomy Technical Note (TN) 190, AGR.7, *Adaptive Nutrient Management Process.*
- Using site-specific yield maps with a yield monitoring system, multispectral imagery or other methods. Use the data to further delineate low- and high-yield areas, or zones, and make the necessary management changes. Use variable rate nutrient application based on site-specific factor variability. See NRCS Agronomy Technical Note (TN) 190, AGR.3, *Precision Nutrient Management Planning*.
- Waste management system planning, storage, and treatment needs to ensure efficient timings of waste application to crops as well as land area requirements for proper waste utilization.
- Induced deficiencies of nutrients due to excessive levels of other nutrients and the effect of soil pH on the availability of both soil and applied sources of plant nutrients and the optimum pH range of the crop to be grown. The optimum pH range of the crop to be grown as well as the effect of soil pH on the availability of plant nutrients both from soil reserves and applied sources.
- Application methods and timing that reduce the risk of nutrients being transported to ground and surface waters or into the atmosphere. Suggestions include, but are not limited to:
  - Split applications of nitrogen (fertigation, side dressing) to provide nitrogen at times of maximum crop utilization.
  - Avoiding winter nutrient application for spring seed crops.
  - Avoiding nutrient applications in close proximity to surface waters (streams, ditches, pond, etc.) surface inlets, and well heads.
  - Banding nutrients, especially phosphorus near the seed row.
  - Applying nutrients uniformly to application areas (broadcast or banded), or as prescribed by precision agricultural techniques.
  - Timely incorporation of land applied manures or organic by-products, in a manner and timing that minimizes soil erosion.
  - Delaying field application of animal manures or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.
- Other soil, plant, and manure tests, such as the Pre-sidedress Nitrogen Test (PSNT), the Cornstalk Nitrogen Test, the Leaf Chlorophyll Meter, Small Grain Fall Soil Nitrate Test, and the Soil P Saturation Ratio (PSR) that provide further information on in-season crop nutrient needs and/or monitor the success of the nutrient management practices being used.
- Minimizing the impact of odors of land-applied animal manure or organic amendments by applying when temperatures are cool and when wind direction is away from neighbors. Consider injection or incorporation of manure or other organic by-products as a means to minimize odors.

- Ammonia-N volatilization losses from fertilizers and animal manures can become significant if available nutrients are not incorporated into the soil in a timely manner after application. Volatilized ammonia represents the loss of a valuable plant nutrient and can also potentially have a negative impact on water and soil quality upon re-position.
- Modifying animal manure composition, by chemical amendments or by modification of the animal's diet, to enhance the producer's ability to manage manure more effectively.
- Alternative uses to land application of manure or organic by-products, including the re-distribution of these materials to nutrient Deficit areas and the production of value-added products, such as pelletized fertilizers and compost.
- The environmental effects of pathogens and other disease-causing organisms in nutrient sources.
- The use of planned grazing systems to reduce the need for storing, hauling and spreading manure.

PLANS AND SPECIFICATIONS

Nutrient management plans shall include a statement that the plan was developed based on requirements of the current standard and any applicable federal, state, or local regulations, policies, or programs, which may include the implementation of other practices and/or management activities. Changes in any of these requirements may necessitate a revision of the plan.

Specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.

A completed 590 Implementation Requirements sheet is required when the practice is enrolled in an NRCS financial assistance program.

In the nutrient management plan, document the following:

- Aerial site photograph(s), imagery, topography, or site map(s).
- Soil survey map of the site.
- Soil information including: soil type, surface texture, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and ponding frequency.
- Location of designated sensitive areas and the associated nutrient application restrictions and setbacks.
- Location of nearby residences, or other locations where humans may be present on a regular basis, that may be impacted if odors or PM are transported to those locations.
- Results of approved risk assessment tools for N, P, and erosion losses, as applicable.
- All available test results (e.g. soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient budget and management plan are based.
- Current and planned plant production sequence or crop rotation.
- Realistic yield goals for the crops (where applicable for developing the nutrient management plan).
- Nutrient recommendations for N, P, and K for the entire plant production sequence or crop rotation.
- When soil P levels are increasing above an agronomic level, include a discussion of the risk associated with P accumulation and a proposed P draw-down strategy.
- Listing, quantification, application method and timing for all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports, and onsite transfers.
- Guidance for implementation, operation and maintenance, and recordkeeping.

Where applicable, the following components shall also be included in the nutrient management plan:

- Type, number, and average size of animals.

- Quantities of manure generated annually, total amount of manure used on the farm each year, including any imported manure, and amount and destination of all manure exported.
- Conservation practices and management activities needed to reduce the potential for nutrient movement from the site.

For precision/variable rate nutrient management plans, also include:

- Geo-referenced field boundary and data collected that was processed and analyzed as a GIS layer or layers to generate nutrient or soil amendment recommendations per management zone. Must include site-specific yield maps using soils data, current soil test results, and a yield monitoring system with GPS receiver to correlate field location with yield.
- Nutrient recommendation guidance and recommendation equations used to convert the GIS base data layer or layers to a nutrient source material recommendation GIS layer or layers.
- After implementation, provide application records per management zone or as applied map within individual field boundaries (or electronic records) documenting source, timing, method, and rate of all nutrient or soil amendment applications.

If increases in soil P levels are expected above an agronomic level (i.e., when N-based rates are used), also document the following:

- Soil P levels at which it is desirable to convert to P-based planning.
- A long-term strategy and proposed implementation timeline for soil test P drawdown from the production and harvesting of crops.
- Management activities or techniques used to reduce the potential for P transport and loss.
- For AFOs, a quantification of manure produced in excess of crop nutrient requirements.

Supporting Data and Documentation

The following is a list of the minimum data and documentation to be recorded in the case file:

- Location of the practice on the conservation plan map.
- Soil map.
- Location of designated sensitive areas or resources and the associated nutrient management restrictions (e.g., setbacks).
- Assistance notes. Document the following:
    - That the producer verified the nutrient management plan was developed by a Maryland certified nutrient management consultant and is current according to State Law.
    - That the producer verified he/she is implementing the nutrient management plan according to State Law.
    - As appropriate, the notes shall also include dates of any site visits, name or initials of the person who made the visit, and specifics as to nutrient management plan adjustments or modifications made by the certified nutrient management specialist (if NRCS is providing this service).
- Completed IR sheet (required only for financial assistance).
- University of Maryland Phosphorus Management Tool (UM-PMT) evaluations, if applicable.

OPERATION AND MAINTENANCE

The client is responsible for safe operation and maintenance (O&M) of this practice including all equipment.

At a minimum, the following components shall be addressed in the O&M plan, as applicable:

- Review or revise plans periodically to determine if adjustments or modifications are needed. At a minimum, review and revise plans as needed with each soil test cycle, changes in manure management, volume or analysis, plants and crops, or plant and crop management.
- Monitor fields receiving animal manures and biosolids for the accumulation of heavy metals and P in accordance with University of Maryland guidance and state law.
- For animal feeding operation, significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.
- Calibrate application equipment to ensure accurate distribution of material at planned rates. For products too dangerous to calibrate, follow University of Maryland or equipment manufacturer guidance on proper equipment design, plumbing, and maintenance.
- Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation to explain the difference.
- Protect workers from and avoid unnecessary contact with nutrient sources. Take extra caution when handling anhydrous ammonia or when managing organic wastes stored in unventilated tanks, impoundments, or other enclosures.
- Use material generated from cleaning nutrient application equipment in an environmentally safe manner. Collect, store, or field apply excess material in an appropriate manner.
- Recycle or dispose of nutrient containers in compliance with State and local guidelines or regulations.

Record Keeping

Maintain records for at least 5 years to document plan implementation and maintenance. Records must include:

- All test results (soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient management plan is based.
- Listing and quantification of all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports and onsite transfers.
- Date(s), method(s), and location(s) of all nutrient applications.
- Weather conditions and soil moisture at the time of application, elapsed time from manure application to rainfall or irrigation event(s).
- Plants and crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and plant or crop residues removed.
- Dates of plan review, name of reviewer, and recommended adjustments resulting from the review.
- For precision/variable rate nutrient management plans, also include:
- Maps identifying the variable application location, source, timing, amount, and placement of all plant and crop nutrients applied.
- GPS-based yield maps for crops where yields can be digitally collected.

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